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A NEW SPECIES OF *TRIOXYS* (HYMENOPTERA: BRACONIDAE: APHIDIINAE) PARASITIC ON THE BIRD CHERRY-OAT APHID, *RHOPALOSIPHUM PADI* (L.) (HEMIPTERA: APHIDIDAE) IN THE PACIFIC NORTHWEST

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Abstract.—***Trioxys sunnysidensis*** **Fulbright and Pike, n. sp.,** is described and illustrated. This aphidiine parasitoid, found in central Washington, is considered a native species, reared from the bird cherry-oat aphid, *Rhopalosiphum padi* (L.), on potted wheat placed outdoors in reed canary grass, *Phalaris arundinacea* L. It is one of two *Trioxys* species known to attack *Rhopalosiphum* in North America.

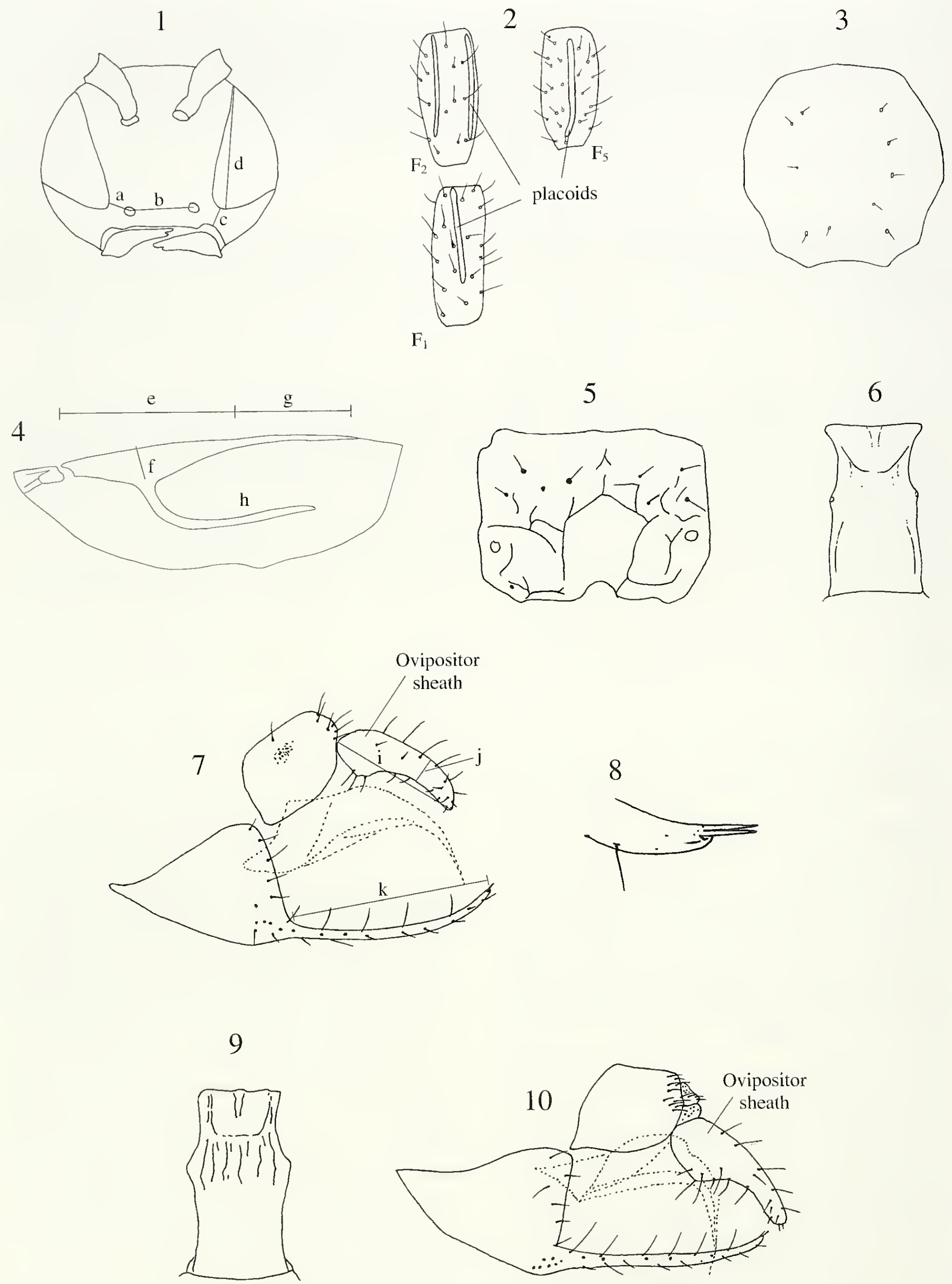
Key Words: parasitoid, aphidiine, aphelinid, *Trioxys*, aphid, *Rhopalosiphum*, wheat, new species, *Phalaris*

Parasitic wasps have been used to control pest aphids in various crop settings (van den Bosch et al. 1959, 1970; Starý 1973; Starý and Remaudière 1993; AliNiazee and Hagen 1995; AliNiazee and Messing 1995; González et al. 1995; Miller and Pike 1997). These beneficial wasps, known as aphidiids and aphelinids, are highly mobile insects that can move between habitats (Starý 1972, Starý and Pike 1999). In the authors' studies of canal bank grasses (primarily reed canary grass, *Phalaris arundinacea* L.) as a refuge for aphid parasitoids in proximity to agricultural lands, an undescribed aphidiid parasitoid of *Trioxys* Haliday attacking the bird cherry-oat aphid, *Rhopalosiphum padi* (L.), was discovered. It is herewith named and described. A brief summary of the reported native and introduced parasitoids of *R. padi* in North America is also provided.

Materials and Methods

Reed canary grass, *Phalaris arundinacea*, grows naturally and abundantly along many roadside ditches, canals, and riverbanks in Washington State. Wheat, artificially infested with *R. padi*, was placed for four days in reed canary grass habitats along the Sunnyside Valley Irrigation District main canal in central Washington's lower Yakima Valley. Exposures to naturally occurring parasitoids were undertaken in June, July, and August of 2005 and 2006. Following exposure, infested plants were held in-lab in screened containers at temperatures of approximately 20–23°C for 30 days for parasitoid development and recovery. No other aphids, other than *R. padi* were observed in any of the exposed wheat recoveries.

Descriptive morphology is after Sharkey and Wharton 1997. Specimens were



Figs. 1–10. Morphological features (not to scale). 1–8, *Trioxys sunnysidensis*. 1, Head (a, tentorio-ocular distance; b, intertentorial distance; c, malar space; d, eye length). 2, Antennal flagellomeres. 3, Mesoscutum (setal number and arrangement shown). 4, Forewing (e, stigma length; f, stigma width; g, R1 [= metacarpus]; h, RS vein [radial sector]). 5, Propodeum. 6, Petiole. 7, Ovipositor sheath, seventh metasomal sternite prong and genitalia (i, ovipositor sheath length; j, ovipositor sheath width at narrower

slide mounted whole or dissected (after techniques by P. Starý, modified by G. Graf of Washington State University) and measured as follows:

Whole mount.—1) specimen immersed in 95 % ETOH; 2) specimen transferred to test tube of water and inverted several times; 3) water decanted, 10% KOH added and tube placed in heating block for approximately 2 minutes at 98°C; 4) specimen transferred to test tube of water and inverted several times; 5) specimen placed in 3 drops of mounting medium (200 g gum arabic, 550 g chloral hydrate, 60 ml glycerin, and 400 ml distilled water, mixed and filtered through glass wool) and positioned; 6) coverslip placed over specimen; 7) collection code written on slide; 8) slide placed on slide warmer for 2–3 weeks at 50°C to allow mounting medium to harden; 9) mount sealed around coverslip with glyptal to prevent dehydration and crystallization; 10) slide fully labeled.

Dissected mount.—1) specimen placed in a mounting medium; 2) head separated from body using fine, sharply pointed insect pins; 3) mesonotum, wings (sometimes left attached to mesonotum), propodeum, petiole (sometimes left attached to propodeum or metasoma), hind legs, and genitalia with ovipositor sheath and prongs (sometimes left attached to metasoma if protruding) separated; and 4) parts positioned in medium (e.g., dorsal view of mesonotum, lateral view of genitalia).

Measurements.—Whole and dissected mounts were reticle measured using a Zeiss Axiolab™ dissecting microscope at magnifications of 50–400×.

Trioxys sunnysidensis Fulbright and Pike, new species

Figs. 1–8

Diagnosis.—*Trioxys sunnysidensis* is characterized by a 12-segmented antenna, rarely 11-segmented, with flagellar segments 1, 2, and 5 each of similar length and width, and by its current host range. The prongs of the seventh metasomal sternite bear 4–5 dorsal setae, 6–8 ventral setae, and 2 straight, simple bristles on the upper side of the apex.

A Eurasian species, *Trioxys auctus* (Haliday 1833) is the only other *Trioxys* species in North America known to attack species of *Rhopalosiphum* (Starý and Remaudière 1977). It is similar to *T. sunnysidensis* (Figs. 6, 7) but *T. auctus* may be distinguished by the following features: dorsal striations on the petiole and differences in the shape of the ovipositor sheath (see Figs. 9, 10).

Description.—Female. *Head.* (Fig. 1): Eyes averaging 161 µm in length, range: 135–175 µm. Malar space equal to 1/5 of eye length. Antenna usually 12-segmented, rarely 11-segmented. Flagellar segment 1 (=F1) (Fig. 2, Table 1) averaging 2.5× as long as wide, usually with 1 or 2 placoids; F2 (Fig. 2) approximately equal in width and length to F1, with 1 or 2 placoids; F5 (Fig. 2) approximately equal in width and length to F2. *Mesosoma* (Fig. 3): Mesoscutum with 6–11 pleural setae. Propodeum (Fig. 5) carinate with pentagonal areola (sometimes open posteriorly), and 7–12 anterior propodeal setae. *Forewing* (Fig. 4, Table 1): Stigma triangular, tapering into R1 (Fig. 4). Radial sector 3× as long as stigma width. *Metasoma*: Petiole (Fig. 6) about twice as long as width across

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distal region; k, length of prong). 8, Apical bristles of seventh metasomal sternite prong. 9–10, *Trioxys auctus* (redrawn after Starý 1976). 9, Petiole. 10, Ovipositor sheath, seventh metasomal sternite prong and genitalia.

Table 1. Feature measurements (µm), counts, and comparisons of female and male *Trioxys sunnysidensis* (from paratype series, n = 19 females, n = 9 males).

	Female		Male	
	Avg.	(Range)	Avg.	(Range)
Head				
Antenna flagellomeres				
F1 (length)	79	(70–90)	85	(75–100)
F2 (length)	79	(70–95)	92	(75–110)
F5 (length)	81	(70–95)	98	(80–110)
F1 (width)	32	(25–40)	37	(30–45)
F2 (width)	33	(25–40)	33	(25–40)
F5 (width)	36	(30–40)	36	(30–45)
Antennal placoids				
F1 (no.)	1.4	(1.0–2.0)	2.0	(2.0–2.0)
F2 (no.)	1.9	(1.0–2.0)	2.0	(2.0–2.0)
F5 (no.)	2.0	(2.0–2.0)	2.0	(2.0–2.0)
Eye (length)	161	(135–175)	144	(130–165)
Malar space (length)	32	(25–40)	36	(30–40)
Inter-tentorial distance	92	(80–100)	89	(80–95)
Tentorio-ocular distance	30	(25–35)	33	(30–40)
Mesosoma				
Mesoscutal pleural setae (no.)	8.0	(6.0–11.0)	7.8	(5.0–11.0)
Wing				
Stigma (length)*	299	(280–320)	297	(260–325)
Stigma (width)	78	(75–90)	77	(60–90)
R1 (length)*	159	(130–180)	148	(120–180)
Radial sector vein	252	(210–280)	245	(210–275)
Propodeal setae, anterior area (no.)	9.3	(7.0–12.0)	7.5	(5.0–9.0)
Metasoma				
Petiole				
length	191	(150–225)	164	(145–185)
width at spiracular tubercles (1°)	97	(80–120)	81	(75–90)
Genitalia				
Ovipositor sheath (length)	170	(150–185)		
Ovipositor sheath (width)	29	(25–35)		
Prong (length)	237	(225–265)		
Prong dorsal setae (no.)	4.6	(4.0–5.0)		
Prong ventral setae (no.)	7.0	(6.0–8.0)		
Comparisons				
Malar space / eye	0.2	(0.1–0.3)	0.3	(0.2–0.3)
F1 (length / width)	2.5	(2.0–3.4)	2.3	(2.1–3.3)
F2 (length) / F1 (length)	1.0	(0.9–1.1)	1.1	(1.0–1.1)
F2 (length / width)	2.4	(2.1–3.0)	2.8	(2.3–3.4)
F5 (length / width)	2.2	(1.9–2.8)	2.8	(2.3–3.7)
F5 (length) / F2 (length)	1.0	(0.9–1.1)	1.1	(1.0–1.2)
Petiole (length /width at 1° tubercle)	2.0	(1.6–2.4)	2.0	(1.9–2.1)
Stigma (length / width)	3.8	(3.3–4.2)	3.9	(3.5–4.3)
Stigma (length) /R1 (length)	1.9	(1.7–2.3)	2.0	(1.8–2.5)
Ovipositor (length / width)	6.0	(4.9–7.2)		

* Troublesome to define, as stigma tapers into R1; measurements should be viewed as estimates – R1 measured from a point of roughly constant thickness.

spiracular tubercles. Ovipositor sheath length slightly $<$ 6× sheath width at midpoint of narrower distal region of sheath (Fig. 7). Sheaths distinctly emarginate ventrally. Prongs relatively long and narrow with 2 straight, simple bristles at apex (Fig. 8); with 4–5 dorsal and 6–8 ventral setae. *Color:* Head black to dark brown, palpi brown. Antenna dark brown, except scape, pedicel, and narrow base of F1 light brown. Mesosoma black to dark brown. Wing venation light brown. Legs brown to light brown. Metasoma blackish brown to brown. Petiole light brown. Ovipositor sheaths dark blackish brown to brown. Seventh metasomal sternite prongs brown. Body 1.6–2.1 mm.

Male. Antenna 13-segmented. Coloration similar to female. Body 1.2–1.4 mm.

Material examined.—Holotype ♀ (whole mount, dry): USA, Washington, Yakima Co., Sunnyside Valley Irrigation District main canal, 6 July 2006, J. Fulbright, collector. Reared from *Rhopalosiphum padi* (L.) on artificially infested wheat plants (*Triticum aestvum* L. var. Alpowa) placed in stands of reed canary grass, *Phalaris arundinacea* L. on the canal bank. Deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). Paratypes: 40 specimens, from the same location as holotype, reared from *R. padi* in June and July 2005 and 2006. Paratypes deposited in collections of USNM (5 ♀, 3 ♂), Washington State University, Prosser (15 ♀, 11 ♂), and P. Starý, Czech Republic (5 ♀, 1 ♂).

Etymology.—The name is derived from the type locality, the Sunnyside Valley Irrigation District main canal in central Washington's lower Yakima Valley.

Discussion

As previously stated, *T. sunnysidensis* and *T. auctus* both attack species of *Rhopalosiphum*. *Trioxys auctus*, of Eurasian origin, has been reported in Québec to attack *Rhopalosiphum nymphaeae* (L.) (Starý and Remaudière 1977), while in the Mediterranean region it is known to attack *R. padi* (Starý 1976).

The bird cherry-oat aphid, *Rhopalosiphum padi*, has a wide distribution in the temperate zones of the northern and southern hemispheres (Pike 1985). It is common on small grains and a wide array of grasses. Within the Pacific Northwest, *R. padi* is attacked by a diversity of aphidiine parasitoids: *Diaeretiella rapae* (M'Intosh) (Pike et al. 1997); *Monoctonus washingtonensis* Pike and Starý and *Praon yakimanum* Pike and Starý (Pike and Starý 1995); *Aphidius ervi* Haliday, *Lysiphlebus testaceipes* (Cresson), *Praon occidentale* Baker, and *Praon unicum* Smith (Pike et al. 1996, Pike et al. 2000); and *Aphidius avenaphis* (Fitch) and *A. matricariae* Haliday (Pike et al. 2000).

The appearance of *R. padi* on *Phalaris arundinacea* is relatively common (Pike et al. 2000). Stands of *P. arundinacea* in Washington State, when infested with aphids, generally carry higher densities of *R. padi* than all other aphids combined (Pike unpublished data). However, it is not yet known whether *R. padi* is the premier host of *T. sunnysidensis*. Research to determine other hosts of *T. sunnysidensis* is in progress.

Although *R. padi* was parasitized by *T. sunnysidensis* on wheat plants placed in reed canary grass along the canal, there have been no records of *R. padi* being parasitized as such in agricultural wheat fields. The parasitoid is apparently more closely linked with the reed canary grass habitat. This habitat is common along waterways and roadsides where runoff water collects. Many of the areas lie adjacent to small grains, but the absence of *T. sunnysidensis* on grain crops as a whole, and its lack of movement into such fields limits its value as a biological control agent.

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